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A Web Community for Digitising Cultural Heritage Assets

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***Abstract*—In this paper we describe the HeritageTogether project, which is developing a web-based photogrammetry and archiving service focused on the megalithic monuments of Wales. The project aims to involve the community by crowdsourcing digital images of heritage assets for the construction of 3D models of the heritage assets. The digital archive will provide a record of potentially at-risk and lost heritage and allow future analysis based on the recorded data.**

I. Context

Photogrammetry and Structure-from-Motion (SfM) allow the use of photographs to create a 3D model of an object through feature matching. They have become established techniques used by archaeologists for recording sites (from excavations to architecture) and artefacts because they allow the preservation of a 'snapshot' of the site Green et al. (2014).

Archaeological excavations are destructive to the site being excavated, and the sites are under constant threat of weather erosion and urban development; preserving a digital record of how the site looked at a certain point in time will allow off-site and future analysis of sites which will likely no longer exist in their recorded state.

Large numbers of heritage sites are situated in their original outdoor environments, often spread across a large geographical area. For example, there are over 2500 megalithic monuments such as standing stones, cairns and burial chambers across Wales alone. Due to this large spatial spread, it can be difficult for heritage organisations to regularly visit and survey such sites.

II. Objective

HeritageTogether is a web platform which aims to tackle this problem. Focusing on megalithic monuments in Wales, the project employs a crowdsourcing model to gather images for photogrammetry by asking contributors from the general public to visit and photograph sites of interest, to allow the production of greater numbers of 3D models.

Fig. 1: Photograph of Bodowyr Burial Chamber a Neolithic chambered tomb on the Isle of Anglesey, UK.

III. Method

The website has three distinct sections: an information area, a gallery and a forum. The information area contains guides on the sites and how to photograph them, as well as providing information on the process of photogrammetry and details of the events being held as part of the project's community engagement. The gallery provides a means for the contributors to upload their own photographs, view and rate those taken by others and view the 3D models produced from the photographs. The forum allows the contributors and project's teams members to interact with each other, and contributors are encouraged to share their experiences of visiting sites. An example of an uploaded photograph can be seen in figure 1, and the model created from those photographs is shown in figure 2.

The 3D models are processed server-side by a member of the administration team; this procedure is performed

Fig. 2: 3D model of Bodowyr Burial Chamber, created using a set of 257 photographs.

manually by selecting an image album and initiating the photogrammetry process. This process is a batch script automating the SfM workflow on the images in the selected album.

The SfM workflow involves several steps of analysing the photographs then using them to estimate the scene structure. First, keypoints from matched features between images are identified using VLfeat Vedaldi & Fulkerson (2010), an open source implementation of the Scale Invariant Feature Transform (SIFT) algorithm Snavely, Garg, Seitz & Szeliski (2008), Snavely, Seitz & Szeliski (2008). From the keypoints, the camera position and pose can be estimated using a sparse bundle adjustment system, producing a sparse point cloud Snavely, Garg, Seitz & Szeliski (2008), Snavely, Seitz & Szeliski (2008). The estimated camera poses and positions are used to produce a dense point cloud using Clustering View for Multi-view Stereo (CMVS) and Patch-based Multi-view Stereo (PMVS2) Lazebnik et al. (2007), Furukawa et al. (2010). The resulting dense point cloud is meshed using a Poisson reconstruction algorithm Bolitho et al. (2009), and a texture is created from an averaged mosaic of the photographs used in the construction of the model. To make the model suitable for viewing in a web browser, the model is heavily decimated using Quadric Edge Collapse Decimation and exported in the X3D file format. The gallery utilises the X3DOM server-side WebGL software to present the models to the viewer without requiring that they download additional software Behr et al. (2009).

Currently the SfM processing is initiated by a member of the project team to ensure a degree of moderation of the uploaded image content. We will be extending these privileges to trusted and experienced users in a hierarchical fashion to ensure high quality, relevant content and scalability.

IV. Results

The website was launched in January, and in 6 months has received over 9000 photographs from contributors, allowing the creation of 50 models. A month-long exhibition featuring an interactive application on a Samsung SUR40 display table, and a number of workshops have provided opportunities to engage with the public and promote contributions to the project.

There are a number of improvements planned for the web platform, including the development of a virtual museum-style interface to display the 3D models. A research portal is being developed to allow open access to the data generated over the course of the project. The data will be made available to the general public and archaeological archives such as the Archaeology Data Service (ADS), for any purpose.

V. Novelty

While online photogrammetry services such as Autodesk's 123D Catch and Microsoft's Photosynth are already available, they simply provide a service to the user and are not focused on gathering data for any other purpose. HeritageTogether is a goal-oriented online community, aiming to gather the largest collection of photographs of megalithic monuments in Wales. Contributing members of the public are able to see their own photographs turned into 3D models, and aid archaeologists in the preservation of heritage assets. By encouraging local communities and the general public to participate in the documentation and preservation process, the project aims to inspire people to learn more about and establish personal connections to their own local heritage.

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